

**FINAL REPORT  
MARCH 2005**



**REPORT NO. 04-14**

**TRANSPORTABILITY TESTING  
OF THE ENGINEER EQUIPMENT TRAILER (EET),  
TP-94-01,  
"TRANSPORTABILITY TESTING PROCEDURES"**

Prepared for:

Distribution Unlimited:

**Marine Corps Systems Command  
Product Group - Ground Transportation & Engineer Systems  
Program Manager - Engineer Systems  
2200 Lester Street  
Quantico, VA 22134-6050**



**VALIDATION ENGINEERING DIVISION  
MCALESTER, OKLAHOMA 74501-9053**

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MARCH 2005

**TRANSPORTABILITY TESTING OF THE  
ENGINEER EQUIPMENT TRAILER, TP-94-01, REV. 2, JUNE 2004,  
"TRANSPORTABILITY TESTING PROCEDURES"**

**ABSTRACT**

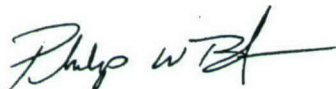
The U.S. Army Defense Ammunition Center (DAC), Validation Engineering Division (SJMAC-DEV), was tasked by the Program Manager – Engineer Systems, Marine Corps Systems Command to conduct transportability testing on the Engineer Equipment Trailer (EET). The EET was manufactured by Holden Industries, Southwest City, MO. The testing was conducted in accordance with TP-94-01, Revision 2, June 2004, "Transportability Testing Procedures."

The objective of the testing was to evaluate the EET, when transportability tested in accordance with TP-94-01, Revision 2, June 2004.

The tie-down rings and anchors on the EET performed adequately during testing. The utilized test loads were effectively and efficiently secured using the tie-down provisions, as designed. The trailer, as currently designed, is adequate for the transport of bulk ammunition.


However, the trailer, as designed, cannot transport a full 10-ton payload of ammunition. The ammunition loads were secured forward of the deck plates and limited to 5,020 pounds (120MM Tank Ammunition) and 5,380 pounds (155MM Separate Loading Projectiles), to prevent overloading of the trailer lunette.

Prepared by:



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Reviewed by:



JERRY W. BEAVER  
Chief, Validation Engineering Division





REPLY TO  
ATTENTION OF

DEPARTMENT OF THE ARMY  
US ARMY DEFENSE AMMUNITION CENTER  
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SJMAC-DEV (70-1pp)

12 April 2005

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1. Enclosed please find subject report dated March 2005.
2. The POC is the undersigned, SJMAC-DEV, DSN 956-8908.

FOR THE DIRECTOR:

JERRY W. BEAVER  
Chief, Validation Engineering Division

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**U.S. ARMY DEFENSE AMMUNITION CENTER**

**VALIDATION ENGINEERING DIVISION  
MCALESTER, OK 74501-9053**

**REPORT NO. 04-14  
TRANSPORTABILITY TESTING OF THE  
ENGINEER EQUIPMENT TRAILER (EET),  
TP-94-01, REVISION 2, JUNE 2004 "TRANSPORTABILITY TESTING  
PROCEDURES"**

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## **PART 1 – INTRODUCTION**

**A. BACKGROUND.** The U.S. Army Defense Ammunition Center (DAC), Validation Engineering Division (SJMAG-DEV), was tasked by the Program Manager - Engineer Systems, Marine Corps Systems Command to conduct transportability testing on the Engineer Equipment Trailer (EET). The EET was manufactured by Holden Industries, Southwest City, MO. The testing was conducted in accordance with TP-94-01, Revision 2, June 2004, "Transportability Testing Procedures."

**B. AUTHORITY.** This test was conducted IAW mission responsibilities delegated by the U.S. Army Joint Munitions Command (JMC), Rock Island, IL. Reference is made to the following:

1. AR 740-1, 15 June 2001, Storage and Supply Activity Operation.
2. OSC-R, 10-23, Mission and Major Functions of U.S. Army Defense Ammunition Center (DAC) 21 Nov 2000.

**C. OBJECTIVE.** The objective of the testing was to evaluate the EET, when transportability tested in accordance with TP-94-01, Revision 2, June 2004.

**D. CONCLUSION.** The tie-down rings and anchors on the EET performed adequately during testing. The utilized test loads were effectively and efficiently secured using the tie-down provisions, as designed. The trailer, as currently designed, is adequate for the transport of bulk ammunition.

However, the trailer, as designed, cannot transport a full 10-ton payload of ammunition. The ammunition loads were secured forward of the deck plates and limited to 5,020 pounds (120MM Tank Ammunition) and 5,380 pounds (155MM Separate Loading Projectiles), to prevent overloading of the trailer lunette.

## **PART 2 - ATTENDEES**

### **ATTENDEE**

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### **PART 3 - TEST EQUIPMENT**

1. Trailer, EET

Manufactured by: Holden Industries, Southwest City, MO

Manufacture Date: 12/2003

MFG. Serial Number: 12HTS31254S109391

Curb Weight: 10,440 pounds

Payload Max: 20,000 pounds

2. Truck, Cargo, 7-ton w/o Winch

Manufactured by: Oshkosh Truck Corporation, Oshkosh, WI

Date of Manufacture: 1/2004

NSN: 2320-01-465-2174

Serial No: 071519

Vehicle ID: 10TDMWE 302S071519

Max Cargo: 30,000 pounds

Max Trailer: 22,000



## **PART 4 - TEST PROCEDURES**

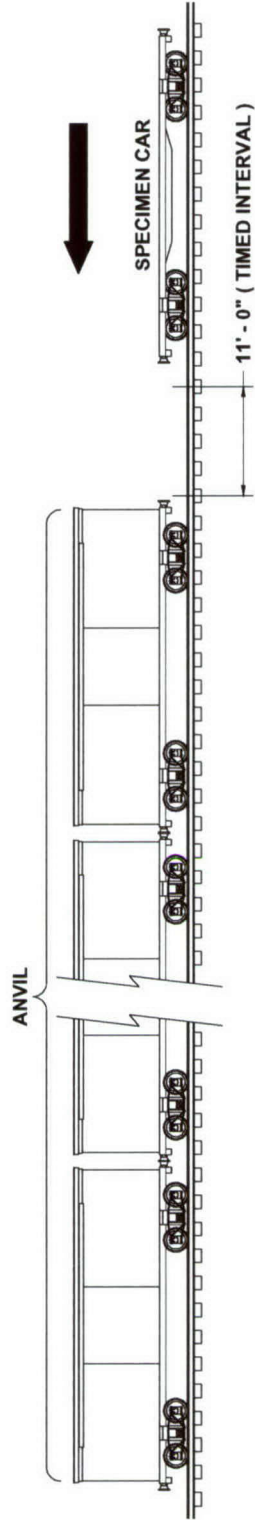
The test procedures outlined in this section were extracted from TP-94-01, "Transportability Testing Procedures," Revision 2, June 2004, for validating tactical vehicles and outloading procedures used for shipping munitions by tactical truck, railcar, and ocean-going vessel.

Inert (non-explosive) items were used to build the load. The test loads were prepared using the blocking and bracing procedures proposed for use with munitions (**see Part 6 for procedures**). The weight and physical characteristics (weights, physical dimensions, center of gravity, etc.) of the test loads were similar to live (explosive) ammunition. The following tests identified are normally required for transportability certification. However, not all tests will be required for some specific items.

**A. RAIL TEST. RAIL IMPACT TEST METHOD.** The test load or vehicle will be secured to a flatcar. The equipment needed to perform the test will include the specimen (hammer) car, four empty railroad cars connected together to serve as the anvil, and a railroad locomotive. The anvil cars will be positioned on a level section of track with air and hand brakes set and with draft gears compressed. The locomotive unit will push the specimen car toward the anvil at a predetermined speed, then disconnect from the specimen car approximately 50 yards away from the anvil cars allowing the specimen car to roll freely along the track until it strikes the anvil. This will constitute an impact. Impacting will be accomplished at speeds of 4, 6, and 8.1 mph in one direction and at a speed of 8.1 mph in the reverse direction. The tolerance for the speeds is plus 0.5 mph, minus 0.5 mph for the 4 mph and 6 mph impacts, and plus 0.5 mph, minus 0 mph for the 8.1 mph impacts. The impact speeds will be determined by using an electronic counter to measure the time for the specimen car to traverse an 11-foot distance immediately prior to contact with the anvil cars (see Figure 1).

# ASSOCIATION OF AMERICAN RAILROADS (AAR)

## STANDARD TEST PLAN



4 BUFFER CARS (ANVIL)

WITH DRAFT GEAR COMPRESSED AND AIR  
BRAKES IN A SET POSITION

ANVIL CAR TOTAL WT. 250,000 LBS (APPROX)

SPECIMEN CAR IS RELEASED BY SWITCH ENGINE  
TO ATTAIN: IMPACT NO. 1 @ 4 MPH  
IMPACT NO. 2 @ 6 MPH  
IMPACT NO. 3 @ 8.1 MPH

THEN THE CAR IS REVERSED AND RELEASED BY  
SWITCH ENGINE TO ATTAIN:

IMPACT NO. 4 @ 8.1 MPH

Figure 1. Rail Impact Sketch

## B. ON/OFF ROAD TEST.

1. **HAZARD COURSE.** The test load or vehicle will be transported over the 200-foot-long segment of concrete-paved road consisting of two series of railroad ties projecting 6 inches above the level of the road surface. The hazard course will be traversed two times (see Figure 2).

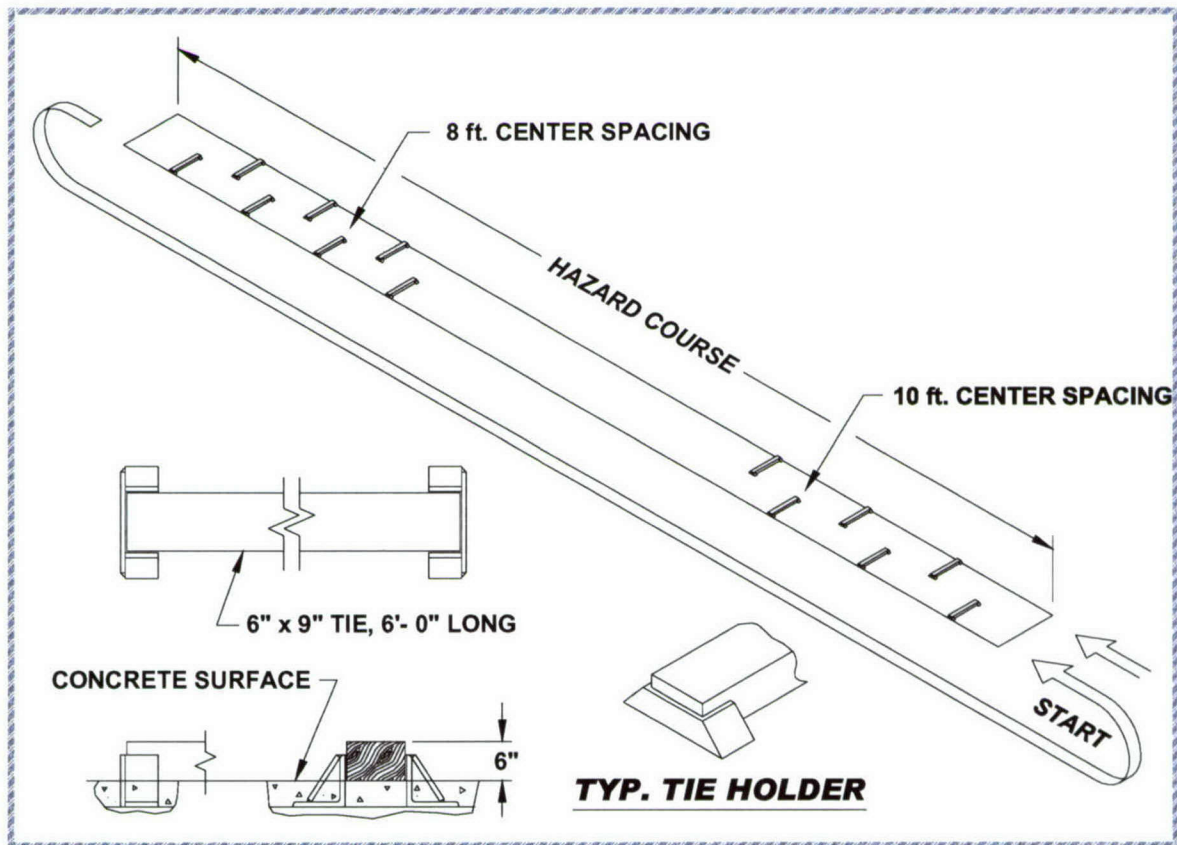


Figure 2. Hazard Course Sketch

- a. The first series of 6 ties are spaced on 10-foot centers and alternately positioned on opposite sides of the road centerline for a distance of 50 feet.
- b. Following the first series of ties, a paved roadway of 75 feet separates the first and second series of railroad ties.



c. The second series of 7 ties are spaced on 8-foot centers and alternately positioned on opposite sides of the road centerline for a distance of 48 feet.

d. The test load is driven across the hazard course at speeds that will produce the most violent vertical and side-to-side rolling reaction obtainable in traversing the hazard course (approximately 5 mph).

**2. ROAD TRIP.** The test load or vehicle will be transported for a distance of 30 miles over a combination of roads surfaced with gravel, concrete, and asphalt. The test route will include curves, corners, railroad crossings and stops and starts. The test load or vehicle will travel at the maximum speed for the particular road being traversed, except as limited by legal restrictions.

**3. PANIC STOPS.** During the road trip, the test load or vehicle will be subjected to three (3) full airbrake stops while traveling in the forward direction and one in the reverse direction while traveling down a 7 percent grade. The first three stops are at 5, 10, and 15 mph while the stop in the reverse direction is approximately 5 mph. This testing will not be required if the Rail Impact Test is performed.

**4. WASHBOARD COURSE.** The test load or vehicle will be driven over the washboard course (see Figure 3) at a speed that produces the most violent response in the vertical direction.

**C. OCEAN-GOING VESSEL TEST. 80-DEGREE TILT TEST.** The test load (specimen) shall be positioned on level terrain with the bottom corner fittings resting on timbers so the entire container is supported solely by the bottom corner fittings. The timbers shall be oriented parallel to the end rails of the container and extend 2 feet beyond the corner fittings on each side. Using two mobile cranes and appropriate rigging, the container shall be rotated (tilted) using the bottom corner fittings on one side as a fulcrum. The rigging (slings) of one

crane shall be attached to the bottom corner fittings of the long side and the rigging (slings) of the second crane shall be attached to the top corner fittings on the opposite side. The tilting shall be accomplished by lifting the bottom corner fittings with the first crane so the container rotates about the opposite bottom corner fittings (fulcrum). Lifting/rotating by the first crane is continued until the center of gravity passes over the fulcrum, at which point the second crane shall provide support to the container and lower the container to the 80 degrees, plus or minus 2 degrees position. Rotation shall be accomplished smoothly at a slow speed so the container sidewall is subjected only to the static force of the interior load. The crane booms shall be adjusted to maintain a rear vertical suspension of the rigging at all times. In the case of end-opening type containers, at least one door (lower side of tilted container) must be closed and fastened throughout the test. The container shall be held in the tilted position for a minimum of two minutes. At which time, observations of both the container structure and the interior load shall be made. When the test is completed, the container shall be returned to its upright position using the same manner and care in handling.

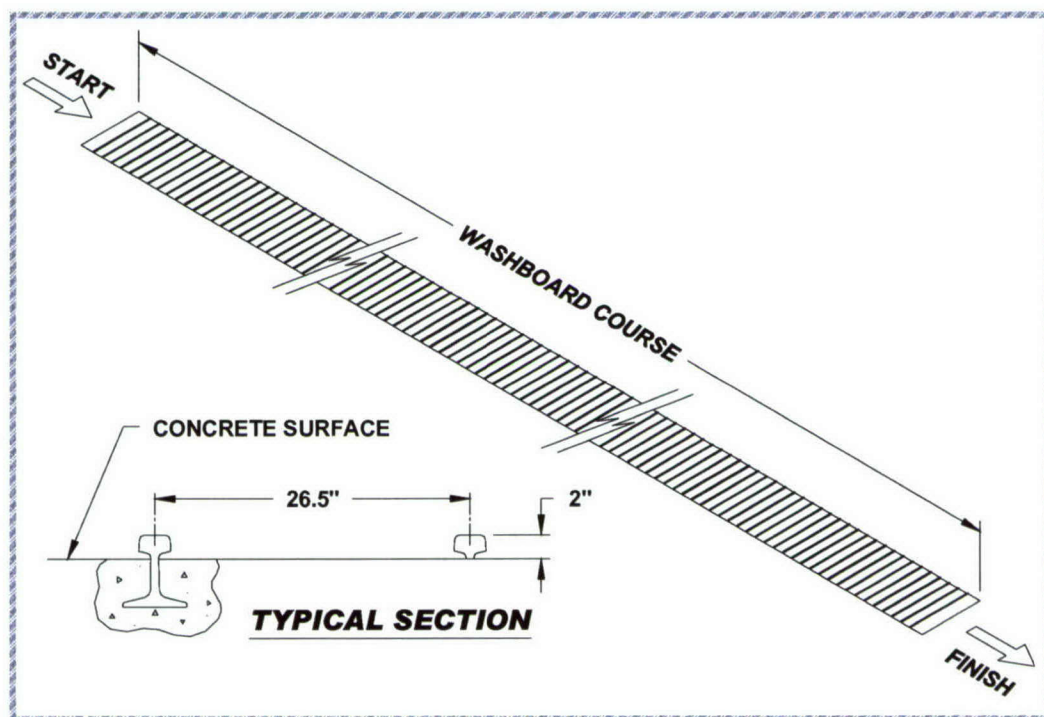


Figure 3. Washboard Course Sketch



## **PART 5 - TEST RESULTS**

### **5.1**

Testing Date: 3 February 2005

Test Specimen: Engineer Equipment Trailer (EET)

Payload: 120MM Tank Ammunition on Metal Pallets

Test Gross Weight: 43,420 pounds (including the Medium Tactical Vehicle Replacement (MTVR), EET and 120MM Tank Ammunition)

Payload Weight: 5,020 pounds

Lunette Weight: 2,800 pounds

#### **A. ON/OFF ROAD TESTS.**

##### **1. HAZARD COURSE.**



**Photo 1. Hazard Course Testing of the EET with 120MM Tank Ammunition**

<b>Pass No.</b>	<b>Elapsed Time</b>	<b>Avg. Velocity (mph)</b>
<b>1</b>	<b>24 Seconds</b>	<b>6.4</b>
<b>2</b>	<b>26 Seconds</b>	<b>5.9</b>

**Figure 1.**



**Remarks:**

1. Figure 1 lists the average speeds of the test load through the Hazard Course.
2. Inspection following Pass #1 revealed that the payload had moved 0.5-1.0 inches toward the front of the trailer and 1.0-1.5 inches toward the passenger side.
3. Inspection following Pass #2 revealed that the payload had moved an additional 0.25 inches toward the passenger side.

**2. ROAD TRIP:****Remarks:**

1. The Road Trip was conducted between the Road Hazard Course Passes #2 and #3.
2. Inspection following the completion of the Road Trip revealed that the payload had moved an additional 0.75 inches toward the passenger side.

**3. PANIC STOPS:****Remarks:**

1. The Panic Stops were conducted during the Road Trip.
2. Inspection following the completion of the Panic Stops revealed no additional movement of the payload.

**4. HAZARD COURSE:**

Pass No.	Elapsed Time	Avg. Velocity (mph)
3	27 Seconds	5.7
4	24 Seconds	6.4

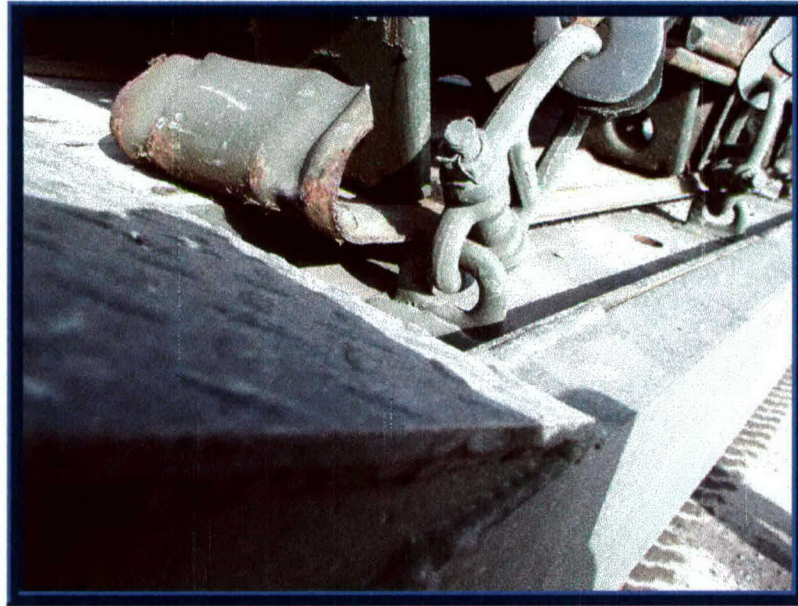
Figure 2.

**Remarks:**

1. Figure 2 lists the average speeds of the test load through the Hazard Course.
2. Inspection following Pass #3 revealed that the payload had moved 2.0 inches toward the driver's side. The base of the pallets received damage from impact

with the tie-down anchors. Wood dunnage could be added along the outside pallet edge that may prevent the pallets from impacting the tie-down anchors.

3. Inspection following Pass #4 revealed that the payload had moved 1.5 inches toward the passenger side and 0.5 inches toward the front of the trailer.



**Photo 2. Contact of the Metal Pallet with the Tie-Down Anchor**

#### **5. WASHBOARD COURSE:**

**Remark:** Inspection following the completion of the Washboard Course testing revealed that the pallets had moved 0.5 inches toward the front of the trailer.



**Photo 3. Washboard Course Testing of the EET with 120MM Tank Ammunition**

**D. CONCLUSION:** Throughout testing the tie-down rings and anchors on the EET performed adequately. The utilized test loads were effectively and efficiently secured using the tie-down provisions as designed. No damage occurred to the tie-down rings or anchors.



## 5.2

Testing Date: 8 February 2005

Test Specimen: Engineer Equipment Trailer (EET)

Payload: 155MM Separate Loading Projectiles (SLPs)

Test Gross Weight: 43,780 pounds (including the Medium Tactical Vehicle Replacement (MTVR), EET and the 155MM SLPs)

Payload Weight: 5,380 pounds

Lunette Weight: 3,080 pounds

### A. ON/OFF ROAD TESTS.

#### 1. HAZARD COURSE.



Photo 4. Hazard Course Testing of the EET with 155MM SLPs

Pass No.	Elapsed Time	Avg. Velocity (mph)
1	26 Seconds	5.9
2	26 Seconds	5.9

Figure 3.

**Remarks:**

1. Figure 3 lists the average speeds of the test load through the Hazard Course.
2. Inspection following the completion of Pass #1 revealed that the payload did not move but the front cross strap loosened.

**2. ROAD TRIP:**

**Remarks:**

1. The Road Trip was conducted between the Road Hazard Course Passes #2 and #3.
2. Inspection following the completion of the road trip revealed that the payload had moved 1-inch toward the passenger side.

**3. PANIC STOPS:**

**Remarks:**

1. The Panic Stops were conducted during the Road Trip.
2. Inspection following the completion of the Panic Stops revealed no additional movement of the payload.

**4. HAZARD COURSE:**

Pass No.	Elapsed Time	Avg. Velocity (mph)
3	26 Seconds	5.9
4	25 Seconds	6.1

**Figure 4.**

**Remarks:**

1. Figure 4 lists the average speeds of the test load through the Hazard Course.
2. Inspection following Pass #3 revealed that the payload moved an additional 1.5 inches toward the passenger side.
3. Inspection following Pass #4 revealed that the payload moved an additional 2 inches toward the passenger side.

## 5. WASHBOARD COURSE:

**Remark:** Inspection following the completion of the Washboard Course testing revealed that the rear pallets moved 1-inch toward the passenger side and the front pallet moved 1-inch toward the driver's side.



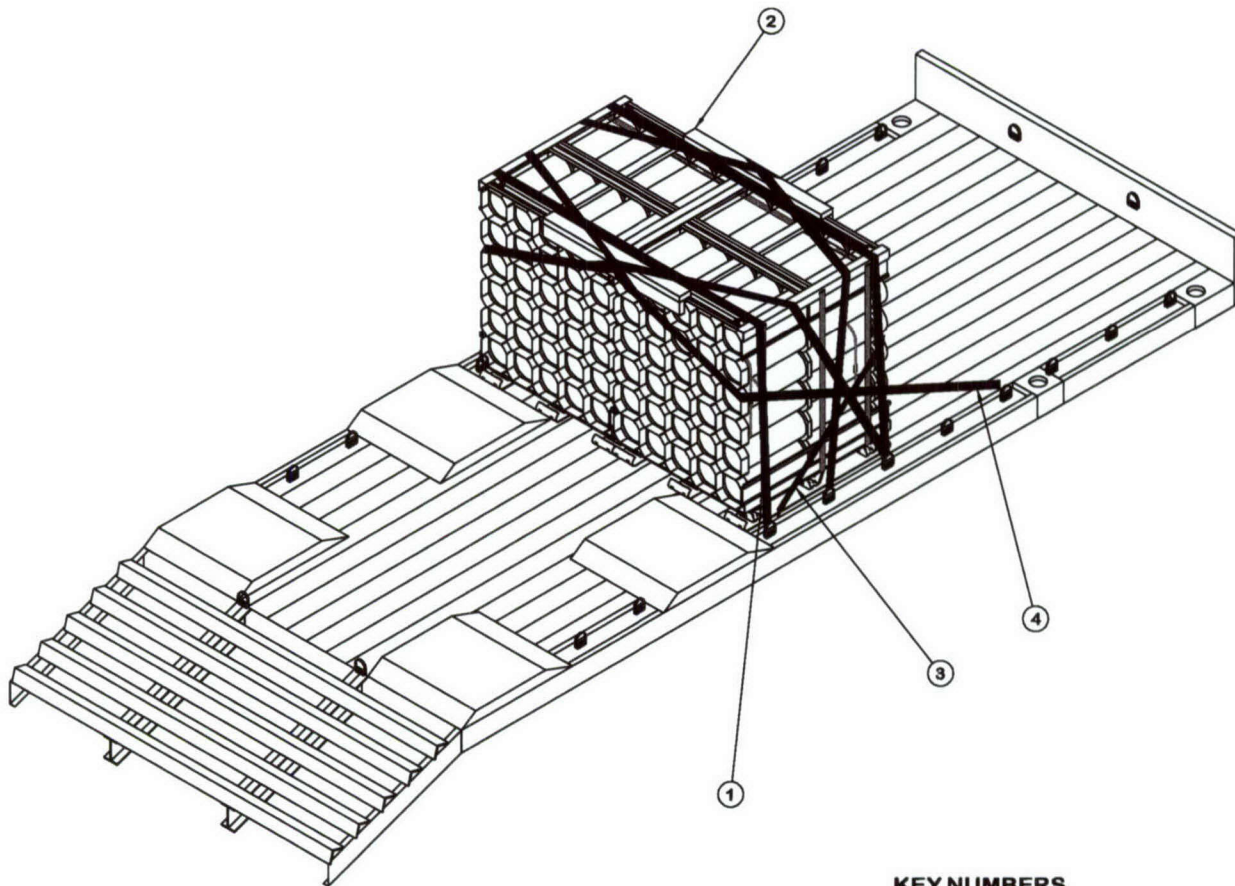
**Photo 5. Washboard Course Testing of the EET with 155MM SLPs**

**C. CONCLUSION:** Throughout testing the tie-down rings and anchors on the EET performed adequately. The utilized test loads were effectively and efficiently secured using the tie-down provisions as designed. No damage occurred to the tie-down rings or anchors.



## **PART 6 – DRAWINGS**

The following drawing represents the load configuration that was subjected to the test criteria.

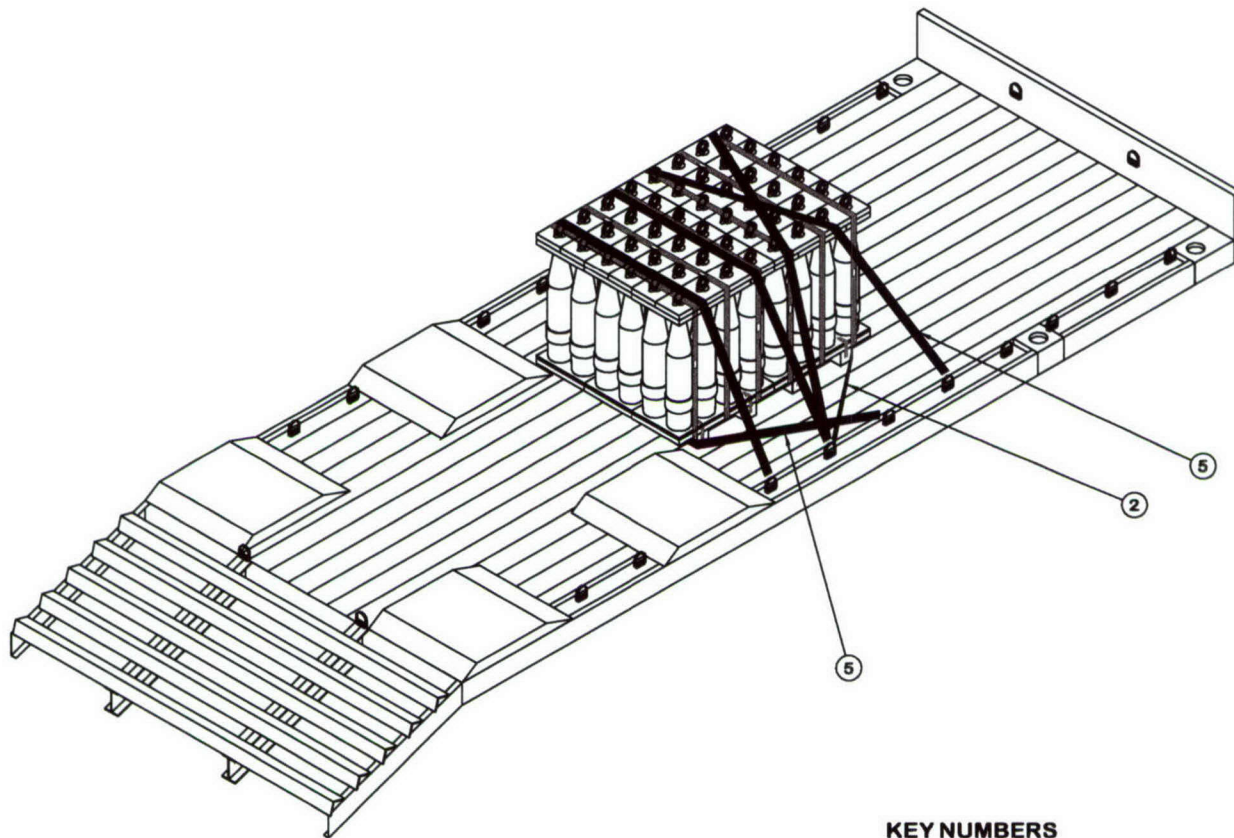


**ISOMETRIC VIEW**

**KEY NUMBERS**

- ① WEB STRAP TIEDOWN ASSEMBLY (2 REQD). INSTALL THE STRAP TO EXTEND FROM A TIEDOWN ANCHOR ON ONE SIDE OF THE DECK, OVER THE PALLET UNITS TO A TIEDOWN ANCHOR ON THE OPPOSITE SIDE OF THE DECK.
- ② TOP EDGE PROTECTION ASSEMBLY, (2 REQD). POSITION ON TOP OF THE PALLET UNITS AT THE FRONT AND REAR OF THE LOAD AS SHOWN.
- ③ WEB STRAP TIEDOWN ASSEMBLY (2 REQD). INSTALL THE STRAP TO EXTEND FROM THE EIGHTH TIEDOWN ANCHOR ON ONE SIDE OF THE DECK, AROUND THE FRONT OF A FORWARD PALLET UNIT, OVER THE FORWARD EDGE PROTECTOR AND DOWN TO THE SEVENTH TIEDOWN ANCHOR ON THE OPPOSITE SIDE OF THE DECK AS SHOWN.
- ④ WEB STRAP TIEDOWN ASSEMBLY (2 REQD). INSTALL THE STRAP TO EXTEND FROM THE FOURTH TIEDOWN ANCHOR ON ONE SIDE OF THE DECK, OVER THE PALLET UNIT AND THE REAR EDGE PROTECTOR AND ACROSS THE BACK OF A REAR PALLET UNIT TO THE SIXTH TIEDOWN ANCHOR ON THE OPPOSITE SIDE OF THE DECK AS SHOWN.

**120MM LOAD ON EET TRAILER**



**ISOMETRIC VIEW**

**KEY NUMBERS**

- ① WEB STRAP TIEDOWN ASSEMBLY (2 REQD). INSTALL THE STRAP TO EXTEND FROM A TIEDOWN ANCHOR ON ONE SIDE OF THE DECK, OVER THE PALLET UNITS TO A TIEDOWN ANCHOR ON THE OPPOSITE SIDE OF THE DECK. NOTE: THERE SHALL BE A MINIMUM OF TWO STRAPS PASSING OVER THE TOP AND SECURING EACH GROUP OF PALLET UNITS ACROSS THE WIDTH OF THE LOAD.
- ② WEB STRAP TIEDOWN ASSEMBLY (2 REQD). INSTALL THE STRAP TO EXTEND FROM THE SEVENTH TIEDOWN ANCHOR ON ONE SIDE OF THE DECK, AROUND THE FRONT OF THE SKIDS ON THE FORWARD PALLET UNITS AND TO THE SEVENTH TIEDOWN ANCHOR ON THE OPPOSITE SIDE OF THE DECK AS SHOWN.
- ③ WEB STRAP TIEDOWN ASSEMBLY (2 REQD). INSTALL THE STRAP TO EXTEND FROM THE SIXTH TIEDOWN ANCHOR ON ONE SIDE OF THE DECK, AROUND THE REAR OF THE SKIDS ON THE REAR PALLET UNITS AND TO THE SIXTH TIEDOWN ANCHOR ON THE OPPOSITE SIDE OF THE DECK AS SHOWN.

**155MM LOAD ON EET TRAILER**